



October 24, 2011

Dr. Jeffrey Wong, PhD
Department of Toxic Substances Control
Office of the Chief Scientist
P.O. Box 806
Sacramento, CA 95812-0806

Subject: Formal Request for Chemical Information and Analytical Test Methods for Specified Nanomaterials

Dear Dr. Wong:

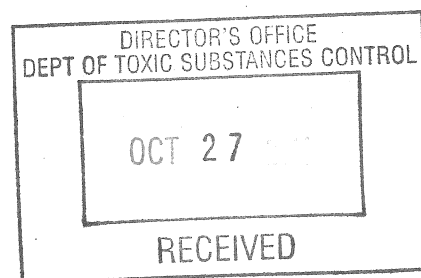
This letter is responding to the December 21, 2010 letter from the Department of Toxic Substances Control (DTSC) for information regarding the chemical and physical properties of certain nanomaterial products. The DTSC has identified AMEC Geomatrix, Inc. (AMEC) as a manufacturer of nanomaterial products. However, AMEC is not a manufacturer or purveyor of nanomaterial products; AMEC is an environmental and geotechnical consulting and engineering services firm. Therefore, AMEC respectfully requests that DTSC remove AMEC from its list of nanomaterial manufacturers. AMEC has had only very limited involvement with nanomaterials, which included a pilot test described below.

In 2006, AMEC conducted a pilot test in Palo Alto, California under the oversight of the California Water Resources Control Board, San Francisco Bay Region. The test was designed to assess the feasibility of nano-scale zerovalent iron (nZVI) as a potential remediation technology at a chlorinated solvent release site. Researchers from Auburn University were involved with the project. These researchers developed a method to produce very small quantities of nZVI particles. One of the researchers from Auburn assisted with pilot test – his role was to oversee the preparation of a test solution containing nZVI. During the pilot test, a total of 248 grams of nZVI was produced. This injected into the subsurface test interval for the purposes of evaluating nZVI transport. A research paper was published in the Journal of Contaminant Hydrology on these results:

Bennett, P., F. He, D. Zhao, B. Aiken and L. Feldman, 2010, *In situ testing of metallic iron nanoparticle mobility and reactivity in a shallow granular aquifer*, Journal of Contaminant Hydrology, 1116:35-46.

A copy of the above research paper is attached for your files. Based on the results of the pilot test, nZVI was not selected as a remedy for the site and AMEC has not produced nZVI at other California sites.

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I hope this letter satisfies your request for information. If you require any further information, please call me at 510-663-4256.

Sincerely yours,
AMEC Geomatrix, Inc.

A handwritten signature in black ink, appearing to read "P. Bennett", with a long horizontal stroke extending to the right.

Peter Bennett, PG #7902
Senior Hydrogeologist

pb/smm
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cc: Hamid Saebfar (DTSC), hsaebfar@dtsc.ca.gov



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In situ testing of metallic iron nanoparticle mobility and reactivity in a shallow granular aquifer

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ABSTRACT

This paper describes the results of a series of single well push–pull tests conducted to evaluate the in situ transport of carboxymethyl cellulose (CMC) stabilized nanoscale zero-valent iron (ZVI) particles in saturated sediments and their reactivity toward chlorinated ethenes. CMC-stabilized nanoscale ZVI particles were synthesized on site by reducing ferrous ions with borohydride in water in the presence of CMC. Nanoscale ZVI and bimetallic ZVI–Pd nanoparticle suspensions were prepared and injected into depth-discrete aquifer zones during three push–pull tests. The injected nanoparticle suspensions contained a conservative tracer (Br^-) and were allowed to reside in the aquifer pore space for various time periods prior to recovery by groundwater extraction. The comparison between Br^- and Fe concentrations in extracted groundwater samples indicated that the CMC-stabilized nanoscale ZVI particles were mobile in the aquifer but appeared to lose mobility with time, likely due to the interactions between particles and aquifer sediments. After 13 h in the aquifer, the nanoscale ZVI particles became essentially immobilized. During the push–pull test with injection of Fe–Pd nanoparticles, ethane concentrations increased from non-detectable to 65 $\mu\text{g/L}$ in extracted groundwater within less than 2 h of reaction time, indicating the rapid abiotic degradation of chlorinated ethenes. The amount of total chlorinated ethene mass destroyed was low presumably because the injected solutions “pushed” the dissolved chlorinated ethenes away from the injection well, without substantial mixing, and because stationary (sorbed) chlorinated ethene mass on the aquifer sediments was low. In situ remediation programs using highly reactive metallic nanoparticles should incorporate delivery methods that maintain high groundwater pore velocities during injection to increase advective transport distances (e.g. groundwater circulation wells). Also, source zones with abundant stationary contaminant mass that is accessible by advective transport should be targeted for remediation with the nanoparticles, as opposed to portions of dissolved plumes, in order to maximize the in situ destruction of contaminants.

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